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Analyzing Questionnaire Editing to Improve Data Quality: Results from the 1996 Agricultural Resource Management Study

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ANALYZING QUESTIONNAIRE EDITING TO IMPROVE DATA QUALITY: RESULTS FROM THE 1996 AGRICULTURAL RESOURCE MANAGEMENT STUDY. By

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ABSTRACT

The Agricultural Resource Management Study (ARMS) collects information on production practices, costs, revenues, and assets for farm and ranch operations in three data collection phases. Phase I of the study consists of screening for target commodities. This report focuses on manual editing and imputation in the Phase II and III. Concern about the resources being used on manual editing and imputation led us to study the amount of editing and its potential causes. We began by examining the frequency with which each item on the questionnaire was edited. Next, for each frequently edited question, we examined each questionnaire on which that question had been edited to determine the reason. Finally, we sought patterns in the causes for edits for each question, and made recommendations as to how editing for the question could be reduced.

We conclude that, by analyzing how and where edits are made, we can identify areas where questionnaire design, editing procedures and enumerator training can be improved. We also conclude that, while statistically sound automated imputation methods were appropriate in some cases, manual editing and imputation seemed to be appropriate in others. By making these changes to questionnaires, editing procedures, and enumerator training, editing may be reduced and the quality of data collected increased. Finally, we conclude that similar methods could be employed in a broader range of surveys, particularly the Census of Agriculture.

KEY WORDS

Agricultural Resource Management Study (ARMS); Data Editing; Data Quality; Questionnaire Design.

This paper was prepared for limited distribution to the research community outside the U. S. Department of Agriculture.

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SUMMARY

The Agricultural Resource Management Study (ARMS) collects information on production practices, costs, revenues, and assets for a cross section of farm and ranch operations. The survey is conducted in three phases. Phase I is a screening process, whereby NASS attempts to determine whether particular operations have the commodities of interest for that year's survey. Phase II concentrates on cropping practices and chemical (fertilizer and pesticide) use. Phase III gathers economic information, such as quantities of agricultural products sold, prices received, costs of inputs, and values of assets.

An earlier report (Apodaca and Stanley, 1998) discussed the effectiveness of Phase I. This report focuses on manual editing and imputation in Phases II and III of the study. Concern about the resources being used on manual editing and imputation led us to study the extent and causes of manual editing and imputation. This project is an attempt to look for ways to eliminate the need for editing and imputation by improving survey procedures, questionnaire design and enumerator training, rather than looking for new ways to make edits.

We began by examining the frequency with which each item on the questionnaire was edited for three different versions (representing cow and calf, soybean, and cotton production) of the Phase II questionnaire and one version (cow and calf) of the Phase III questionnaire. First, we identified the most frequently edited questions. Next, for each frequently edited question, we examined each questionnaire on which that question had been edited to determine the reason. Finally, we attempted to find patterns in the causes for edits for each question, and make recommendations for improvements to reduce the number of edits needed in the future.

We conclude that, by analyzing the editing that was done, we can identify areas where procedures, questionnaire design and training can be improved. We also concluded that, for some of the questions where values were not allowed to be missing, it would be better to allow statistically sound imputation methods to be employed. However, this should be determined on a question by question basis, since for many questions there was significant use of enumerator notes on the questionnaire, or information known by the editor from other survey contacts. Finally, we recommend that this sort of editing review become a part of the operational program for surveys where significant resources are being spent on editing. In particular, we recommend that further research be done on applying similar methods to analysis of editing in the Census of Agriculture.

INTRODUCTION

The Agricultural Resource Management Study (ARMS) collects information on production practices, costs, revenues, and assets for a cross section of farm and ranch operations. For 1996, the survey was conducted in three phases. Phase I was a screening process, whereby NASS attempted to determine whether particular operations had a target commodity or commodities in 1996. Phase II concentrated on cropping practices and chemical (fertilizer and pesticide) use. There were separate versions of the Phase II questionnaire for corn, cotton, cow and calf, potato, soybean, tobacco, and wheat producers as well as a version for multiple crop producers. Phase III gathered economic information, such as quantities of agricultural products sold, prices received, costs of inputs, and values of assets. There were separate versions of the questionnaire for corn, cow and calf, and tobacco producers, as well as a version for nonspecific types of farm and ranch operations.

An earlier report discussed the effectiveness of the Phase I [1]. That report also includes a more detailed description of the sample design. This report focuses on manual editing and imputation in the Phases II and III of the study. The ARMS questionnaire is long and complicated compared to those of most other NASS surveys. The questionnaire is administered in a personal interview by an enumerator. The questionnaire is then reviewed for completeness and accuracy by the enumerator's supervisor, and by state office statisticians before and after a machine edit. This process of hand editing and imputation is expensive and time consuming. Concern about the resources being used on manual editing and imputation and the effects

of editing and imputation on data quality led us to study their extent and causes. The basis of this concern was strikingly illustrated by our research which examined only a small percentage of the Phase III completed cases. We found 32 questions that were edited or imputed frequently enough to attract our interest. In our small subset of questionnaires, these 32 questions generated 1,520 edits or imputations.

The objective of this study was to look for ways to reduce the need for editing and imputation by improving the data collection process, rather than looking for new ways to make edits. Our philosophy is captured well in the following quotation from a 1997 article by Leopold Granquist and John Kovar [2]:

In the quest to reduce errors in survey data, it is essential to look upstream, rather than attempting to clean up at the end. The adage "do it right the first time" is very appropriate. Editing results can be used to advantage in sharpening survey concepts and definitions and in improving the survey instrument design. More resources should be dedicated to these functions in order to help prevent errors. . . . However, we have as yet to see a report on an editing process where this principle has been applied, and which resulted in changes to, for example, the questionnaire. . . . The role of editing must be reexamined, and more emphasis placed on using editing to learn about the data collection process, in order to concentrate on preventing errors rather than fixing them.

Seeking information with which to improve enumerator training and questionnaire design is not a new idea in NASS. In fact, there are formal mechanisms for state office personnel

to communicate problems with questionnaires to the headquarters personnel responsible for designing a survey. While useful, these mechanisms rely on subjective, anecdotal evidence to identify problem questions. Such subjective reports of “problem questions” do not always reflect the magnitude of a problem, and many other problems are not reported (especially those considered “minor” or “fixable”). This project relies on an objective measure, the frequency with which edits were made. Further, this project is more comprehensive; every question was examined for frequency of edits.

METHODOLOGY

For the cow and calf version of the Phase II questionnaire, we chose Missouri, Montana, and Texas. For the soybean version of the Phase II questionnaire, we chose Arkansas, Illinois, and Indiana. For the cotton version of the Phase II questionnaire, we chose Arizona, Arkansas, and California. For the cow and calf version of the Phase III questionnaire, we chose Missouri, Montana, Tennessee, and Texas. We selected the cow and calf version of the questionnaire based on anecdotal reports that they required substantial manual review and editing. Crop versions of the questionnaires were also selected since they contain many questions which are different from the livestock questionnaires. The states were chosen in cooperation with the ARMS survey team to represent a cross section of editing experience, geographic location, and had sample sizes which allowed us to examine all questionnaires completed in those states.

We reviewed 778 Phase II (280 cow and calf version, plus 239 soybean version, and 259 cotton version) and 311 Phase III (all cow and calf version) questionnaires. This represented

8% of all completed interviews in Phase II and 4% of all completed interviews in Phase III.

In the ARMS, changes to the data on a questionnaire, based on clerical corrections, may be made by supervisory enumerators. Statisticians may review questionnaires when they reach the State Statistical Office before they are keyed into the computer. These data will then be checked by computer for internal consistency and reasonableness. Data with confirmed or potential problems will be flagged with either a warning or critical error for additional review by statisticians. They may edit data with warning flags as they feel appropriate. Critical errors must be corrected. The computer review routines will also flag missing items which require a response. (Missing items which do not require a response will be coded with a -1.) The SSO statistician is then required to enter data based on a callback to the respondent or other information.

In order to identify edited or imputed responses, we had to examine each questionnaire. We created a data file which contained an entry for every question that was manually edited or imputed. Manually edited data were those for which a number had been entered on the questionnaire that had later been changed by either a supervisory enumerator or a statistician. Manually imputed data were those where there had originally been no data entered on the questionnaire but a supervisory enumerator or statistician had entered data. For each question manually imputed, we tracked whether or not an imputed value was based on additional information on the questionnaire (enumerators frequently made notes on the questionnaire outside of the response boxes). If the entry

was for an edited value rather than a manual imputation, we entered the unedited response.

For each item on the questionnaire we counted the number of times there was no data (that is, the question was not applicable to the operation), the value was missing (that is, the question applied, but there was item non-response), the value was unchanged, the value was manually imputed using notes made on the questionnaire, the value was manually imputed without enumerator notes, or the value was manually edited. We did not examine any automated computer editing done on these data and all editing and imputation discussed in this report refers to manual editing and imputation unless otherwise specified.

For questions in which imputed or edited values constituted ten or more percent of the cases where data were present or, imputations or edits were made ten or more times, a follow-up examination of questionnaires was done. When we detected a pattern of reasons for such changes, we attempted to recommend improvements to survey procedures, the questionnaire or to enumerator training that would reduce the amount of manual data editing and imputation.

RESULTS

This section is divided first into results from the different phases, then into results from the different parts of the questionnaire. The text of each of the questions appears as it did in the questionnaires in Appendix A.

PHASE 2

Fertilizer Table: Soybean and Cotton Versions

Fertilizer data were collected in tables. Each observation, representing a type of fertilizer, was entered in one row of the table. For each fertilizer application, the respondent was asked to supply either the number of pounds of each nutrient (nitrogen, phosphate, or potash) applied, or the percentage analysis of each nutrient, and a total number of pounds. A total of 667 usable observations were analyzed in the five States. The percentage of edited or imputed data for the fertilizer table ranged from 0.6 percent for phosphate to 11.4 percent for the units in which the amount was reported (pounds, gallons, or pounds of actual nutrients). The quantity applied had the second highest percentage of data edited at 5.45 percent.

Unit Code--Reported data were altered 64 times (9.6 percent) for the unit code. Of the 64 changes, 27 or 42.2 percent involved changing the unit code from pounds/gallons to pounds of actual nutrients. Review of the questionnaires revealed in all but a few cases either the quantity applied was left blank or the sum across the three types of nutrients was greater than 100, justifying the inference that actual pounds of nutrients had been reported instead of a percentage analysis. Although the changes were justifiable, more information and/or training may be needed on the proper coding of these cells when actual nutrients are applied.

In addition, 27 (42.2 percent) of the 64 records involved cases where the unit of measurement was reported but edited to a -1 (indicating that the value was missing) because no quantity

was reported (forcing editors to code another -1 for quantity). Although, this is the correct action to take, we must be cautious when we begin to edit out reported data. There were several instances where the same fertilizer composition had different units of measurement reported; if the unit is edited out, are we losing information that may be helpful in the imputation process? Are some types of fertilizer only applied in particular units? If so, should the unit of measurement be included in the imputation group from which data are imputed? Alternatively, perhaps printouts of fertilizer and/or pesticide application rates from records with 'good' data can be made available to SSOs during the editing process to assist them. Table 1 shows the frequency distribution for the Editing Actions for the unit code.

Pesticide Table: Soybean and Cotton Versions

The pesticide table was structured similarly to the fertilizer table. A total of 2,722 usable observations were analyzed in the five States. The percentage of data edited or imputed for the pesticide table ranged from 0.9 percent of the usable cases for the date of application to 7.2 percent for the material unit code. The product used and primary targeted pest at 5.8 percent and 4.7 percent were the next two most frequently edited items. However, the

majority of changes were a result of the product and/or target pest's not being listed in the respondent booklet the interviewer uses for coding during the interview. In order of most frequent occurrence (at least 5 reports) product numbers not found in the respondent booklet were 4560, 1258, 1482, 1102, 1442, and 9079. Target pests not listed were 173, 171, 174, 754, 172, and 180. These products or target pests and their codes could easily be added to the respondent booklet in the future.

Material Unit Code--As mentioned, 7.2 percent (198 records) of the reported data were changed or a positive value was imputed in for the material unit code. Of the 176 edited records, 73 (41.5 percent) had their unit codes changed. Of greater concern, was that only 17.0 percent of the application rates associated with these records were edited, so editors were changing the reported amounts of these chemicals applied. Review of the questionnaire showed that changes made were in green indicating that the change likely occurred after an edit. It seems to us that changing reported amounts of chemicals applied to meet the edit may introduce bias.

Application Rates--The application rate was edited or imputed 92 times (3.3 percent) of the 2,769 records analyzed. Reported data were

Table 1.--Editing Actions: Unit Code from Fertilizer Table, Phase II, Versions 6 and 8

Action	Frequency	Percent
No Change	579	86.8
Edited	64	9.6
Not Answered, -1 imputed to indicate a missing value	12	1.8
Not Answered, positive value imputed without aid of enumerator notes	8	1.2
Not Answered, positive value imputed with the aid of enumerator notes	4	0.6

edited for 67 (72.8 percent) of the 92 records. Initially, these changes may seem to be a result of key-entry or recording errors in the decimal part of reported numbers. (Data were collected to two decimal places.) However, after reviewing the questionnaires the data appeared to be recorded correctly but were increased or decreased by a factor of ten after failing NASS's Survey Processing System (SPS) range edit. In addition there were several cases where the application rates were reduced significantly (unit unchanged) in order to pass the SPS edit, without any indication on the questionnaire that this was correct. If this type of editing action is typical, survey indications may be downwardly biased. Simply editing data so that it falls within edit limits is likely not the optimal procedure to be taken in this situation. However, without any alternative basis to correct data, this is the easiest solution. But caution should be taken when changes are made just to fulfill the edit. Changes in the application rate or the material unit code impact the effective rate of application. The outcome is the same – potential bias.

Stock Flow and Inventory Section: Cow Calf Version

Replacement Heifers--Ten out of 72 records (13.9 percent) with data for *replacement heifers raised on the operation that were bred to produce the calf crop* had their data edited. Six of the ten records had positive data that were edited to zero. Examination of the total number of beef cows and bred heifers on hand that were bred to produce the calf crop, revealed that positive data in this field had been zeroed out as well. Since heifers raised on the operation would have been included in total beef cows and heifers, this explained

heifers raised on the operation being zeroed out. In all of these cases, the total number of beef cows and bred heifers on hand that were bred to produce the calf crop had been zeroed out because the reported number of calves born alive was zero. The assumption of the editors was, clearly, that if no calves had been born, then no cows were bred. This item illustrates the complexity of this questionnaire, with relationships between many of the data items. When possible, related items should be placed near each other on the questionnaire. Also, the relationships should be pointed out during training.

Number of Calves Born Alive--Twelve of 108 records (11.1 percent) with data for number of calves born alive were edited. In eight records, the total was edited to agree with the sum of four detail items asking the number of calves born in each of four time periods during the year. Seven of the twelve records had their data zeroed out to agree with the zeroes in the detail items. Perhaps stressing such relationships in training could prevent some of these edits.

Total Beef Cattle Inventory (12 months ago)--Total Beef Cattle Inventory on Hand 12 Months Ago, was edited 17 of the 184 times (9.2 percent) that it had data. In all of these cases it was changed to be equal to the sum of Item Codes 75-80, which were its constituent parts. In 11 of these cases, none of Item Codes 75-80 were edited. In these cases, stress on getting consistent reports might have reduced the number of edits needed. Alternatively, perhaps this total should be eliminated from the questionnaire. This number can be easily generated by data users, simply by adding the sub-parts, and is clearly not serving as a check or verification of the

sub-parts. In four other cases, edits could not be avoided, since editors made an imputation based on comments like, “don’t know, a few less than last year.”

Grazed Feed Section: Cow Calf Version

Unit Codes--The Unit Codes (e.g. acre, head, cow/calf pair, AUM) for the first and second lines of rented private pasture acres, and the first and second lines of cropland pasture acres were edited 75 out of the 228 times they had data (32.9 percent). In all but five cases, this was done to zero out the unit code when the reported number of units leased or rented was zero. This was a problem in other areas to a lesser degree, when unit codes were filled in, even when the items to which they applied were not. This seems to be another area where stress during training on proper recording in the questionnaire could reduce the number of edits.

Percent of Forage Consumed by Beef Cattle--Between them, percent of forage consumed by beef cattle from private pastures and percent of forage consumed by beef cattle from cropland pastures, were edited 53 out of the 90 times they contained data (58.9 percent). In all but four of these cases, the reported values were 100 percent. The preceding items asked if any animals besides beef cattle were grazing on these pastures. In all of these cases, the reported answer was no. There was an instruction above the percentage of forage consumed by beef cattle questions indicating that if the answers to the questions about other animals besides beef cattle were no, the percentage questions should be skipped. Therefore, interviewers were not following the skip instructions properly. This could be stressed in training, and the questionnaire

designer may be able to make the instructions clearer.

Weight of Bales or Stacks of Harvested Forage--Weight of bales or stacks of harvested forage, was edited 12 of the 102 times it had data (11.8 percent). Nine of the 12 times the unit code had a value of 3, indicating that the reported amount was in tons, not bales or stacks. In these cases, weight of bales or stacks was zeroed out. In the other three cases, bales were reported in the unit code, but weights that were several orders of magnitude too large were reported in weight of bales or stacks, which was then edited to have a reasonable bale weight. Stressing consistency may reduce the need for these edits.

Cow-Calf Labor Section: Cow Calf Version

Was Spouse Paid?--Eighty-five records had data for the question, “Was Spouse Paid?” The item was edited 14 times (16.5 percent of the time). In all but one case, the change was to impute 2 (meaning “no”) when the question had been left blank. Note that, in general, blanks were not equivalent to a “no” response. This may have seemed like an obvious response to some enumerators, but it required making an edit when it was not filled in during the interview. Also, there were records where a spouse was paid, so it is not so obvious after all.

Questionnaire designers could alter the questionnaire to make blank = “no”. Alternatively, additional training to remind interviewers that an entry is required may solve this problem.

Number of Workers--The values for Item Codes 436, 437, and 438, number of workers for the first 3 lines in the labor "table" after self, spouse, and partners, were changed 27 out of 187 times that they contained data (14.4 percent). These lines begin with a column in which the worker(s) are described, usually with a phrase like "hired man," or a name. In the case of a description which implied the number of workers, enumerators sometimes did not fill in the number of workers. The problem with this is that the text description is not keyed into the data file (it has no item code), so, without the number of workers being filled in, we have no way to capture this information. Twenty-five out of the 27 times these fields were changed it was done to enter a number when nothing had been entered. It should be stressed to enumerators that, even where the number is obvious from the text description, they need to enter it anyway. Perhaps the questionnaire could also be modified to indicate that the description field is for enumerators' use only.

Was Non-Spouse Worker Paid?--This item, which asked if the first non-spouse worker had been paid, was edited 13 of the 124 times it had data (10.5 percent). Eleven of the 13 edits were to indicate a pay status when none was reported. Five of the imputations were to impute "unpaid" for records for which no wage rate was reported in Item Code 524, which asked the wage rate. It was not entirely clear to us that this imputation was correct. It might also be that both questions were skipped or refused. Six of the imputations were to impute "paid" for records for which a wage rate was reported. Stressing consistent and complete responses to the enumerators may help in this case.

Was Worker Full Time, Part Time, or Seasonal?--Item Codes 458 and 459, which asked if non-spouse workers were full-time, part-time, or seasonal, were changed 35 of the 135 times they had data (25.9 percent). This problem occurred because these questions were only supposed to be asked if the worker(s) they applied to were paid. In 26 of the 35 cases (74.3 percent) nonzero responses were zeroed out because the response to Item Code 447 or 448 indicated that the worker was unpaid. The entries edited here were correct; however, they were unnecessary. The edit could easily be modified to allow them. Again, stressing consistent and complete responses to enumerators may also help.

Main Section: Soybean Version

Row Width in Inches--Forty out of 145 records (27.6 percent) with data for Row Width in Inches, were changed from a positive amount to zero. Of these forty records, 32 had reported widths of 7 or 8 inches. While we are not experts on soybean cultivation, it is true that narrow row widths are being used more frequently. We suspect that edits are being made here that may not be called for when this many reported values are being changed.

Crop Previously Planted in This Field in the Fall of 1994--For the field crop versions of the questionnaire, a single field was selected randomly from those the operator farmed. The field specific questions referred to this sampled field. There seemed to be fewer problems with the section for crops previously planted in the sampled field in the soybean version than there were in the cotton version. The worst of these items in the soybean version was "What Crop Was Previously Planted in this Field in the Fall of 1994." Of the 238 records with data in this item, 28 (11.8

percent) had changes made. Nine of those changes (32.1 percent) were from “no answer” to “fallow.” Seven changes (25.0 percent) were from positive data to “fallow,” and six changes (21.4 percent) were from durum wheat to winter wheat. These changes were made without guidance from enumerator notes. This seems to be a reporting problem. Respondents may have trouble recalling what was planted and may become confused about which period the question refers to.

Herbicide Resistant Varieties--Of the 239 records with data, 27 (11.3 percent) had “no response” changed to “didn’t use an herbicide resistant variety.” Increasing enumerator awareness of the need to have a response in this item (and that an answer box left blank was not equal to “no”) may have eliminated the need for these edits.

Main Section: Cotton Version

Cotton Acres Harvested for Lint and Cotton Acres Harvested for Seed and Lint--An edit was made in 35 of the 48 cases (72.9 percent) where data were present for acres harvested for cotton lint. Thirty-two of the 35 cases were from California. An edit was made in 33 of the 47 cases (70.2 percent) where data were present for the related item, yield from acres harvested for “cotton seed for planting (*and lint*).” Thirty-one of the 33 cases were from California. Both items were edited on the same questionnaire 32 times.

A review of the data showed that, in all but one case, the edit consisted of zeroing out positive data. Examination of the total acres in the field and number of acres harvested for cotton lint, revealed that the total acres had been reported both in acres harvested for seed (and lint) and in number of acres harvested for

lint. Editors had consistently chosen to zero out the acres reported as harvested for seed (and lint) and its associated yield, and keep the acres reported as harvested for lint. We had some question as to whether or not this was the correct edit, but have no way of knowing without more knowledge of typical practices in California. Regardless, enumerators in California need to be instructed that the same acreage may not be reported in both acres harvested for lint and acres harvested for seed. Also, the questionnaire might be modified to ask, “How many acres were harvested for lint ONLY (no seed for planting)?”

Crops Planted in the Sampled Field During Previous Periods and Whether Those Crops Were Irrigated--The reference period for this study was the year 1996. Item Codes 103-107 ask what crops were planted in the field during earlier periods. Item Codes 108-112 ask whether the crops in 103-107 respectively were irrigated. For records with data in Item Code 103, Crop Planted in the Field in Fall of 1995, an edit was made in 74 of 257 cases (28.8 percent). Five of the changes were from no answer to missing (that is, a -1 was edited in). Of the remaining 69 edits, forty-one were made in Arizona and 24 in California. In Arizona, 30 of the edits (73.2 percent) were changes from cotton (26) or another crop (4) to fallow or zero.

The reasons for these changes were not clear to us, but that may reflect our lack of knowledge of cotton cultivation in Arizona. Still, this seems to be a problem that might be improved by a change in instructions to enumerators. The remaining eleven changes were from no answer to fallow. In California, 17 of the 24 changes (70.8 percent) were from cotton (10) or another crop (7) to fallow.

Table 2.--Results of Editing Item Codes 108-112, "Was this crop irrigated on this field?"¹

Item Code	# of Records w/ Data	# Edited (percent)	Changed from "No Answer" to 1 ² (percent of edited)	Changed from "No Answer" to -1 ³	Other Changes
108	118	17 (14.4)	12 (70.6)	0	5
109	223	65 (29.1)	63 (96.9)	1	1
110	133	32 (24.1)	24 (75.0)	4	4
111	213	67 (31.5)	62 (92.5)	4	1
112	210	64 (30.5)	54 (84.4)	9	1
Total	897	245 (27.3)	215 (87.8)	18	12

¹Refers to all different types of crops.

²1 = Yes, 0 = No.

³-1 = Don't know.

As was seen in the similar question on the soybean version, there may be problems due to respondent recall when you ask the respondent to remember what was in a particular field two or three years earlier. A variety of reasons accounted for the other changes. Item Code 104, crop planted in the field in Spring/Summer of 1995, had only about half as many edits (14.3 percent of records); no analysis of these edits was performed.

Item Code 105, Crop Planted in the Field in Fall of 1994, was similar to Item Code 103. For records with data, 81 of the 259 records (31.3 percent) had changes made. Of these records, 12 were changed from not answered to missing. Again, Arkansas didn't seem to have a problem, with only three records edited, all of which were changes from not answered to fallow. This may reflect differences in the cultivation of cotton in this state. Of the remaining 66 cases, 34 were from Arizona, and 32 were from California. In Arizona, 20 cases (58.8 percent) were changed from cotton (19) or another commodity (1) to fallow. Ten more records were changed from

not answered to fallow. In California, 18 cases (56.3 percent) were changed from cotton (6) or another commodity (12) to fallow. Seven were changed from fallow to winter wheat, and four more from not answered to fallow. Item Codes 106 and 107 were edited 16.2 percent and 17.4 percent of the time; approximately half of these edits were to change not answered to missing.

Table 2 shows the results of editing item codes 108-112. Examination of the individual records revealed that the problem lay primarily in Arizona. Of the responses changed from "No Answer" to "Yes," 198 of the 215 (92.1 percent) were in Arizona. From examining the questionnaires, it was clear that editors were not allowing crops without irrigation. This seems to make sense in Arizona. An automated routine during the machine edit to make this change could eliminate the hand edits being done in these cases.

Units of Seeding Rate per Acre--Of the 259 records with data for units of seeding rate per acre, 33 (12.7 percent) were edited. There

were two causes for this. In 12 of the records (36.4 percent), enumerators had neglected to record the units. In 21 records (63.6 percent), enumerators had recorded the units as number of seeds, when, from the response to seeding rate per acre, it was clear that the units should have been pounds of seeds. Additional emphasis during training may reduce this problem.

Land Use Practices--Of the records that had data for Item Codes 1245-1249, which asked about land use practices, the percentage of records with a -1 coded by an editor ranged from 90.5 to 98.7. Item Code 1250, which asked about the use of other drainage channels or diversions, had -1 edited in 62.8 percent of the time. Item Code 1257, asking if lime is ever applied to the selected field, was edited to have a value of -1 87.4 percent of the time. For all of these fields, the same 76 records from Arizona contained these -1's. Incorporation of this imputation into the automated edit would eliminate the need for doing so many hand edits. Additionally, one must question the value of an item to which so few respondents seem to be able to give an answer.

Boom Height--Of the 238 records which have data in the item for boom height of the pesticide sprayer the first time it was used on the selected field, 46 (17.7 percent) had a -1 edited in to indicate a missing value. This occurred 26 times in Arizona, 6 times in Arkansas, and 14 times in California, so it was not isolated in any particular state. An examination of the questionnaire shows that the problem here is the placement of the question. It occurs as the only question on pages 12 and 13 which is not a part of the pesticide table, and is located in the bottom right-hand corner, where it is easy to lose

track of. Perhaps this item could be moved to a more visible location.

Application of Herbicides before Weeds Emerged--Of the 217 records with data for the item which asked if herbicides were applied before weeds emerged, 31 records were edited. Nineteen of these had a positive response (1=yes) edited in. In all 19 cases, there was a positive response to one of the questions asking what the reason was for using pre-emergence herbicides. In 12 cases, a positive response was changed to "no" (0=no), also apparently based on "No" responses to all of the questions asking about reasons for using pre-emergence pesticides. The relationship between the screening question and the following questions should be reviewed. The assumption here is clearly that the specific reasons for applying herbicides listed in items 7a - d are an exhaustive list. This assumption is being made by both interviewers and editors (and possibly respondents). The number of edits for this field could be reduced by stressing the relationship between the screening question and the following items during training. Questionnaire design might also be modified, for example, to include an "Other" reason as a final item 7e, or to eliminate the screening question and ask all of the individual items (7a - d) of all respondents.

Cultivation for Weed Control--Of the 256 records with data in the item which asked if the field was cultivated for weed control during the season, 22 (8.6 percent) had a positive response edited in. In 20 of the 21 cases, there were responses in Item Codes 1281-1283, indicating the dates on which the field had been cultivated. This is similar to

the previous question, similar recommendations are suggested for this question series.

PHASE 3

Only the cow and calf version of the phase 3 questionnaire was analyzed. The cow and calf version was chosen based on anecdotal evidence that this had been difficult to edit. This phase of the study gathered economic information. No tables were used in the design of the questionnaire. Economic information was gathered for the whole operation; no field-specific information was collected, so no second stage sampling was required.

Rents on Acres and Buildings--This section of the questionnaire asked about cash rents and user fees that the operation paid to others for the use of buildings and land, and cash and share rents that the operation received for land or buildings rented to others. The items in this section were edited between 10 and 25 percent of the time that they contained a positive response. Thirty-one records had at least one of the items edited. Twelve of the 31 had changes based on notes that enumerators had made on the questionnaire. Seven of the 31 had edits made to be consistent with other information on the questionnaire. Another eight had changes made based on outside information (mostly from the November survey or the ARMS Phase Two questionnaire).

The ARMS survey is one of NASS's longest, and there is considerable pressure on enumerators to complete the interview as rapidly as possible, so as to minimize burden on operators and reduce the likelihood of incomplete interviews and future refusals.

Sometimes, under this pressure, enumerators get the information down on the questionnaire as best they can, often in the form of margin notes. Some of the edits in this section can be avoided if it is stressed to enumerators that they need to review the completed questionnaire after the interview. This would allow them to move responses into the appropriate boxes on the questionnaire, and to resolve obvious inconsistencies while the interview is still fresh in their minds. This would also reduce the time spent editing by office statisticians who are often forced to edit based on interpretations of the enumerator's notes.

Landlord's Share of Crop Acreage and Production--When farmers rented land for a share of their crop production, the questionnaire asked what share of each type of crop production went to the landlord. These items were edited 22 of the 189 times (11.6 % of the time) they had data present. Eight imputations were made where other entries on the questionnaire indicated that land was rented for a share of crops. These may be difficult edits to avoid, since they stem from the complexity of the questionnaire. Perhaps they could be incorporated into the machine edit. Seven of the edits were to move data from free-formatted lines meant for state-specific crops to lines for which the crop was already specified. These are discussed as a part of the next category.

State-Specific Crops--Twelve records had a total of 56 edits in state-specific crop fields, including fields for landlord's share when land was share-rented. This may stem from enumerators trying to get information down on the questionnaire. Rather than stop in the middle of the interview to decide if a crop like "hard red winter wheat" or "blue corn" are

really special state-specific crops or are just wheat and corn, the enumerator gets the information down. Many of these edits could be avoided by enumerators' carefully reviewing questionnaires after the interview.

Cost of Maintenance and Repairs--The following explanation will be clearer if the reader refers to the questionnaire page in Appendix A. Sixty-six of the 306 questionnaires with data in this field (IC 205) were edited (21.6 percent). About half (29) of the edits were made because the cost of supplies was included in the cost of maintenance and repairs. Examination of the questionnaire suggested a solution. The fields for supplies and repairs were grouped together under a single boldface heading "Supplies and Repairs." Question 15 asks how much was spent for supplies in 1996. Question 16 has three parts. Part "a" asks for the costs of repairs to vehicles, drying equipment and frost protection equipment. Part "b" asks for the cost of maintaining and repairing fencing and buildings. Part "c" asks for the cost of maintaining and repairing irrigation equipment. Question 17 then asks for the total of the three parts of question 16. It was easy for enumerators to become confused and add supplies (question 15) into this total as well. A modification to visually separate the cost of supplies and the cost of maintenance and repair by placing each under its own bold subheading might eliminate these errors.

The remaining 37 edits and imputations were either made because the total field was left blank, or because arithmetic errors were made in adding the parts of question 16. This suggests that the total could be eliminated since it clearly was not functioning as a check on the sum of items 16a-c. Between more careful review of questionnaires by

enumerators and an addition to the machine edit to take care of these errors automatically, the need for so many hand edits should be eliminated.

Marketing and Production Contracts--Seventy-one of the 432 entries made in these fields (16.4 percent) required edits. We were not successful in determining a dominant cause for the edits in these fields. We believe that some of the problems may have stemmed from editors mistakenly applying numerical relationships between the fields which, based on the instructions, do not necessarily hold. Other than that, this may simply be an area where respondents have a lot of difficulty in giving complete accurate answers.

Other Asset Values Table--This section asked respondents to give the value of several categories of farm assets on December 31 and January 1 of 1996. Concern was with the necessity for obtaining a response (missing values were not allowed for most of these questions), given that respondents seemed to have difficulty with the beginning of the year values. It was not uncommon for respondents to simply give the same answer for both time periods. Almost 30 percent of the values for January 1 were identical to the December 31 values. This likely resulted from a less cognitively effortful behavior, in which a respondent simply said, "About the same," when asked for the beginning-of-year values. Table 3 shows the breakdown by item code for edited and imputed data.

Allowing missing data and applying statistically valid multiple imputation methods would be better here than forcing what are likely to be inaccurate answers or imputations.

Table 3.-- Number of Hand-Imputed and Edited Responses for Questionnaires with Positive Data

Market Value of	Number of Questionnaire s with a Positive Response (N=311)	Number (Percent) of Questionnaire s with Hand- Imputed Data	Number (Percent) of Questionnaire s with Hand- Edited Data	Total (Percent) with Hand- Imputed and Edited Data
Farm share of vehicles, machinery, tools and equipment owned by the operation, December 31, 1996 ¹	301	0 (0.0)	1 (0.3)	1 (0.3)
All livestock and poultry owned by and located on the operation, January 1, 1996	310	14 (4.5)	5 (1.6)	19 (6.1)
How much of livestock and poultry were breeding stock, January 1, 1996	295	14 (4.7) ²	3 (1.0)	17 (5.8)
All crops stored on the operation, January 1, 1996	235	14 (5.6)	0 (0.0)	14 (5.6)
All production inputs owned by the operation (e.g., feed, fuel, chemicals), January 1, 1996 ¹	168	3 (1.8)	1 (0.6)	4 (2.4)
All livestock and poultry owned by and located on the operation, December 31, 1996	311	11 (3.5)	10 (3.2)	21 (6.8)
How much of livestock and poultry were breeding stock, December 31, 1996	298	12 (4.0)	10 (3.4)	22 (7.4)
All crops stored on the operation, December 31, 1996	254	13 (5.1)	2 (0.8)	15 (5.9)
All production inputs owned by the operation (e.g., feed, fuel, chemicals), January 1, 1996 ¹	172	2 (1.2)	1 (0.6)	3 (1.7)
Inputs already used for cover crops or crops not yet harvested, December 31, 1996 ¹	86	0 (0.0)	0 (0.0)	0 (0.0)
All stock in farm cooperatives, December 31, 1996 ¹	61	0 (0.0)	0 (0.0)	0 (0.0)

¹"Minus Ones" indicating a missing value were allowed for these item codes.

²One of these imputations was done using an enumerator note. Enumerator notes were not used to help with hand imputation for the other 13 questionnaires, or for any other item code in this table.

Questions Asking for a Percent or Dollar Breakdown of Another Item--A common type of question asked how much of some item was for the beef cattle enterprise. The questions typically allowed the answer to be given either in dollars or as a percentage. This type of question was often misinterpreted when it followed a multi part question and applied only to the last part.

For example, question six under crop, livestock, and poultry expenses asked how much the operation spent on a number of items. Question 6c asked how much was spent on all bedding and litter. Question 6 c. (1) asked "How much of this (*item 6c*) was for the beef cattle enterprise, excluding feedlot cattle?" Although the question is completely clear that it does not apply to questions 6a and 6b, it had to be edited 69 out of the 86 times it had data (80.2 percent). All of these edits were made because question 6c was blank. Despite the wording, enumerators were interpreting the question as applying to all of 6a, b, and c. We suggest that the lesson to be learned here is that no amount of written instruction can substitute for strong visual cues.

There were other problems with similar questions. The question, "How much of real estate and property taxes were for real estate?" was imputed 22 out of 294 times it had data. Fifteen of these imputations were done with no guidance from other fields on the questionnaire or enumerator notes. This seems to be an area where an automated imputation routine might improve on current practice.

The question, "Of the total marketing charges (*item 12*), how much was for the sale of beef

cattle, excluding feedlot cattle?" was changed 22 out of the 268 of the times it had data (8.2 percent of the time). Half the changes were based on data in other item codes on the same page. This is another case where careful enumerator review of the questionnaire would reduce the need for edits or imputations.

Cash or Open Market Sales--This is another question where there is an opportunity to enter data either on a line for a specific crop, or to enter the data on an open line and supply the name of the crop. Thirty-eight of the 283 times that data were listed on the "other commodities" lines (13.4 percent of the time) they were changed. Twenty three records accounted for these changes. Like the state specific crop section of the acreage and production table, this table often (on 10 of the 23 records) needed to have data moved from one of the free formatted lines to a crop-specific line. As stated above, review of the questionnaire by enumerators following the interview could have prevented most of these edits.

CONCLUSIONS AND RECOMMENDATIONS

By analyzing how and where edits were made, we have been able to identify areas where questionnaire design, editing procedures, and enumerator training could be improved to reduce the amount of editing required and ultimately to both reduce resources spent and improve the quality of the data. Those working on ARMS (or similar survey) questionnaire design should read this report for insight into specific potential questionnaire problems and solutions.

The ARMS team has already reviewed and incorporated some of the suggested improvements to the questionnaire. We would recommend that our analysis of the hand editing be reviewed by others developing similar types of questionnaires or preparing interviewers for future ARMS or similar studies. Questions similar to those we studied would benefit from the specific recommendations listed in this report.

Others may learn some general lessons from this report and its findings.- Problems we uncovered fell into several general areas. First were problems that were related to the questionnaire design. For example, some questions elicited reporting errors due to ambiguous wording. For other questions, layouts did not make it clear where codes were required on the questionnaire, or codes were not available on showcards for common items.

Second, many of the hand editing and imputation could have been reduced or eliminated with enumerator training. For example, several questions required codes for either all or none of a set of responses. Data for sets of items with incomplete information were edited out. This could be solved with increased training on these items, in particular for items where both a quantity and unit code are required.

Increased training on the interrelationships between data items on the questionnaire could also have eliminated some of the manual editing. If questionnaire layout could also be designed to emphasize these data relationships, that would also reduce the amount of statistician editing.

In addition, some of the editing that was done on these data was the result of changing

extreme, but NOT impossible data reported on the questionnaire. This may, perhaps, be reduced by widening machine edit limits but a better solution is to review how extreme values are handled once they are detected.

While we were able to independently conduct this analysis of a small subsample of questionnaires, we recommend that, in the future, such an analysis be incorporated into operational programs. While any one item may have relatively few manual edits or imputations, the cumulative amount of resources devoted to this task by State Office statisticians is quite large. By making substantial reductions in the resources devoted to this, statisticians will be able to devote their attention to problems in the data that truly require their expert review, not simply correcting clerical errors.

We recommend that surveys be identified where significant resources are devoted to editing and the potential for savings in resources or increases in data quality might be substantial. For example, because of the enormity its data collection and editing, the Census of Agriculture would likely benefit greatly from this type of review.

However, when any analysis of editing and imputation is done, it is critical that the staff involved in the ongoing operational program be included in the process. Often, we relied on the expertise of the ARMS team to explain why a question was being asked in a particular way, or to suggest better ways to ask a question we had identified as a possible problem. They are truly the ones who have the knowledge to interpret the results of this analysis.

We also believe that it is most appropriate to embed this kind of process measurement in the work process itself. We recommend that some of the information we had to key enter ourselves, such as an identifier for imputed values, or original values for edited fields, be planned for and captured as part of the data file during data collection and editing. Determining when and why an item was edited was not trivial. There were no indicators on the final data file to indicate whether or not a field had been edited or hand imputed or what the unedited value in the field might have been. Capturing the needed information as part of the regular data collection process would allow analysis of the full data set, rather than a small sub-sample, and these metadata may prove useful for other purposes.

For some of the fields where missing values were not allowed, or where imputations were frequently made without the benefit of enumerator notes, it might be best to incorporate some statistically valid imputation routines into the automated edit and imputation system, rather than force respondents to answer when they do not know the information or force statisticians to make an imputation with little basis for doing so. There is a real data quality concern here. If imputations are done by, for example, imputing the mean, then estimates of variances will be biased low. Also, the very multivariate relationships that users of these data at the Economic Research Service wish to model may be distorted. Sophisticated methods that yield better estimates of the variance and better preserve multi variate relationships are available [3].

Automated imputation routines should NOT be written for all items containing missing

data. A careful review of the reasons for imputations MUST be done before suitable items can be selected for automated imputation routines. Many of the "imputations" being made on these questionnaires were, in fact, based on additional information that was recorded on the questionnaire, but not on the expected lines or in the expected format. Using an automated routine for these items would result in the loss of this information. We found that many of these changes could have been avoided if enumerators were instructed to review their questionnaires prior to submitting them to supervisors or questionnaires were redesigned to enhance proper recording of data.

Clearly, the potential savings in the amount of resources devoted to manual editing and improvements in data quality are important to NASS and data users alike.

REFERENCES

- [1] Apodaca, Mark and Stanley, Jaki, "Evaluation of Phase I Screening For The 1996 Agricultural Resource Management Study," Survey Quality Research Section, Research Division, National Agricultural Statistics Service, 1998.
- [2] Granquist, Leopold and Kovar, John, "Editing of Survey Data: How Much Is Enough?" in Lyberg *et al.*, eds., *Survey Measurement and Process Quality*, p. 430, John Wiley and Sons, Inc., 1997.
- [3] Rubin, Donald, *Multiple Imputation for Nonresponse in Surveys*, John Wiley and Sons, Inc., 1987.

Appendix A-- Selected Questionnaire Page

Phase 2, Cow Calf Version

N

STOCK FLOW and INVENTORY

N

8. From [item 5 date], what was the total number of calves born alive to your [item 6] beef cows and heifers?

NUMBER

0057			

9. How many of the [item 8] calves were born--

PERCENT

OR

NUMBER

- a. during the first 3 weeks (21 days) of the calving season? . . . +
- b. during the 4th through the 6th weeks (22 - 42 days)? . . . +
- c. during the 7th through the 9th weeks (43 - 63 days)? . . . +
- d. after nine weeks (64 days or more)? +

0058
0059
0060
0061
100%

0062
0063
0064
0065

[Total must equal item 8.]

10. During the last 12 months, how many calves died before weaning?

NUMBER

0066

11. How many breeding bulls, cows and replacement heifers (more than one year of age) died or were lost from all causes during the last 12 months? (Exclude feedlot and dairy cattle.)

NUMBER

0067

12. Next I have some questions about beef cattle inventories on the acres operated by this operation. (Exclude dairy cattle.)

1	2 How many head of [column 1] are on hand today? NUMBER	3 How many head of [column 1] were on hand 12 months ago? NUMBER
a. REPLACEMENT HEIFERS	0068	0075
b. BEEF COWS, including bred heifers	0069	0076
c. BEEF BREEDING BULLS weighing 500 pounds or more	0070	0077
d. FEEDLOT CATTLE intended for SLAUGHTER	0071	0078
e. CALVES less than 500 pounds	0072	0079
f. CALVES, YEARLINGS or STOCKERS weighing 500 pounds or more	0073	0080
g. TOTAL (sum and verify columns)	0074	0081

Q

GRAZED FEED

Q

3. Were any of these types of owned or rented land, suitable for crop production, grazed by this operation's beef cattle during the last 12 months? (*Exclude hay.*)

☐ YES - [Complete table below.] ☐ NO - [Go to item 4.]

CROPLAND PASTURE CODES

11 SMALL GRAINS PASTURE	13 CRP
12 CROP RESIDUE	14 OTHER GRAZED FORAGES

FORAGE TYPE CODES

1 GRASSES	5 OTHER SMALL GRAINS
2 LEGUMES	6 CORN STALKS
3 GRASS LEGUME MIXTURE	7 OTHER CROP RESIDUES
4 WHEAT	

[Ask only if col. 4 is positive.]

[Ask only if col. 7 is code 1.]

1 [Use Cropland Pasture Codes.]	AND 2 What was the type of forage? [Use Forage Type Codes.]	3 What was the total number of acres in these pastures?	4 What was the total number of units leased or rented?	5 UNIT CODE 1 ACRE 2 AUM 3 HEAD 4 COW/CALF PAIR	6 What was the TOTAL rent paid during the last 12 months?	7 Did any domestic animals besides your beef cattle graze these pastures? [YES = 1 -- complete column 8.]	8 What percent of the forage consumed from these pastures was by your beef cattle?
CODE	CODE	NUMBER	NUMBER	CODE	DOLLARS	CODE	PERCENT
0223	0227	0231	0235	0239	0243	0247	0251
0224	0228	0232	0236	0240	0244	0248	0252
0225	0229	0233	0237	0241	0245	0249	0253
0226	0230	0234	0238	0242	0246	0250	0254

EDIT TABLE

0301

4. Did this operation apply any herbicides, insecticides, fungicides or other chemicals during the last 12 months on the pasture or range land grazed by your beef cattle, including owned or rented, public or private land? (*Include custom applied materials and spot treatments.*)

T-TYPE
3

TABLE
001

☐ YES - [Complete table below.] ☐ NO - [Go to Section R.]

L I N E	2 What products were applied to the pasture or range land grazed by beef cattle? [Use Product Codes from Respondent Booklet. Use separate lines for each application.]	3 Was this product bought in liquid or dry form? [Enter L or D.]	7 What was the total amount applied per application?	8 UNIT CODE 1 POUNDS 12 GALLONS 13 QUARTS 14 PINTS 15 OUNCES 30 GRAMS
	CODE		CODE	CODE
01	0305		0309	0310
02	0305		0309	0310
03	0305		0309	0310
04	0305		0309	0310
99	OFFICE USE NUMBER OF LINES IN TABLE			0319

NOTES:

T

COW-CALF LABOR

T

1. I need to get some information about labor used for beef cattle production **during the last 12 months**. I would like to list the workers that did beef cattle production work, including management activities.

Please list **ALL** workers, both paid and unpaid, who did **more than one day** of beef cattle production work, including you (the operator) and any partners. (*List individuals or groups of workers.*) (*Exclude haying. Exclude contract and custom labor.*)

[Enumerator Instructions: *First, list the workers in column 1. When all workers are listed, complete the table. If a worker worked both paid and unpaid hours, use separate lines.*]

1 WORKERS	2 [Enter number of workers.] NUMBER	3 Was (worker)-- 1 PAID? 2 UNPAID? CODE	4 [If PAID, ask--] Was (worker)-- 1 FULL TIME? 2 PART TIME 3 SEASONAL? CODE	5 What was the AVERAGE number of hours (worker) worked PER WEEK in the beef cattle operation during the CALVING period? HOURS	6 What was the AVERAGE number of hours (worker) worked PER WEEK in the beef cattle operation during the BREEDING period? HOURS
<input type="checkbox"/> You (the operator)				0415	0416
<input type="checkbox"/> Partners	0420			0421	0422
<input type="checkbox"/> Spouse		0426	0427	0428	0429
	0436	0447	0458	0469	0480
	0437	0448	0459	0470	0481
	0438	0449	0460	0471	0482
	0439	0450	0461	0472	0483
	0440	0451	0462	0473	0484
	0441	0452	0463	0474	0485
	0442	0453	0464	0475	0486
	0443	0454	0465	0476	0487
	0444	0455	0466	0477	0488
	0445	0456	0467	0478	0489
	0446	0457	0468	0479	0490

Phase 2, Soybean Version

D

FIELD CHARACTERISTICS---SELECTED FIELD

D

PARTIAL CROP CODE LIST FOR ITEM 17

190 Barley	8 Cotton	25 Sorghum for grain	163 Wheat, durum
3 Dry Beans	302 CRP	24 Sorghum for silage	164 Wheat, other spring
6 Corn for grain	15 Oats	26 Soybeans	165 Wheat, winter
5 Corn for silage	22 Rice	28 Sugarbeets	318 Fallow or Idle (diverted)

17. Next I need to know what crops were previously planted on this field, **including cover crops**.
[If no crop was planted during the period, use code 318. If crop isn't listed in the code table, record the crop name beside the cell and leave the cell blank.]

1	2 What crop was planted on this field-- [column 1] CODE	3 Was this crop irrigated on this field? YES = 1
a. in FALL of 1995?	0103	0108
b. in SPRING/SUMMER of 1995?	0104	0109
c. in FALL of 1994?	0105	0110
d. in SPRING/SUMMER of 1994?	0106	0111
e. in SPRING/SUMMER of 1993?	0107	0112

18. *[If the most recent crop in item 17 was a SMALL GRAIN, such as barley, oats or wheat ask--]*

Was crop residue removed from this field
 by baling or removing straw, burning, etc.? YES = 1

CODE

1164

D

FIELD CHARACTERISTICS---SELECTED FIELD

D

1. How many acres of soybeans did this operation plant in the selected field in 1996?

ACRES

1151

2. Was this field--

- 1 OWNED BY THIS OPERATION?
 2 RENTED FOR CASH?
 3 SHARE RENTED?
 4 USED RENT-FREE?

CODE

1152

MM DD YY

1153

-- -- 96

5. On what date was this soybean field planted?
 [Use CALENDAR showcard and circle planting date.]

6. Were the soybeans drilled?

CODE

1154

☐ YES [Enter code 1 and go to item 8.] ☐ NO - [Continue.]

INCHES

1155

7. What was the row width in inches?

UNIT CODE
 1 = KERNELS/SEEDS
 2 = POUNDS
 3 = BUSHELS

RATE PER ACRE

1156

1157

8. What was the seeding rate per acre the first time this field was seeded?

9. Was one of these pest resistant varieties of seed used in this field--
 [Show respondent Seed Variety Code List in Respondent Booklet.
 Choose one and enter code.]

- 1 an herbicide (Roundup) resistant hybrid or variety
 (such as:
 Asgrow AG3001, AG3501, AG4401, AG4701,
 AG5601, AG6101,
 Monsanto/Harts H5088RR, H5164RR,
 H5566RR, H6686RR, H7550RR
 Pioneer 9294 or 9363)?

CODE

1158

- 5 none of these?

Phase 2, Cotton Version

D

FIELD CHARACTERISTICS---SELECTED FIELD

D

CODE

1241

14. Has harvest of this cotton field been completed? YES = 1

15. Now I need information about the acres harvested (or to be harvested) and the yield from this cotton field.

1	2 How many acres in the cotton field were (will be) harvested for-- [column 1] ACRES	3 What yield per acre did you get (do you expect to get) for-- POUNDS PER ACRE
d. cotton lint?	0077	0085
e. cotton seed for planting (and lint)?	0078	0086
i. abandoned?	0098	
j. other use?	0099	

PARTIAL CROP CODE LIST FOR ITEM 17

1 Alfalfa hay	5 Corn for silage	16 Peanuts	26 Soybeans
190 Barley	8 Cotton	22 Rye	142 Vegetables
3 Dry Beans	302 CRP	98 Safflower	165 Wheat, winter
310 Clover	311 Grasses other than clover	25 Sorghum for grain	318 Fallow or Idle (diverted)
6 Corn for grain	15 Oats	24 Sorghum for silage	

17. Next I need to know what crops were previously planted on this field, including cover crops.
*[If no crop was planted during the period, use code 318. If crop isn't listed in the code table,
 record the crop name beside the cell and leave the cell blank.]*

1	2 What crop was planted on this field-- [column 1] CODE	3 Was this crop irrigated on this field? YES = 1
a. in FALL of 1995?	0103	0108
b. in SPRING/SUMMER of 1995?	0104	0109
c. in FALL of 1994?	0105	0110
d. in SPRING/SUMMER of 1994?	0106	0111
e. in SPRING/SUMMER of 1993?	0107	0112

E

FERTILIZER and NUTRIENT APPLICATIONS---SELECTED FIELD

E

1. What FERTILIZERS were applied to this field for the 1996 cotton crop? [If none, go to item 3.]
(Include chemical fertilizers. Include custom applied fertilizers. Include fertilizer applied in the fall of 1995 and those applied earlier if this field was fallow. Exclude micro-nutrients.)

EDIT TABLE

0201

T-TYPE
2TABLE
001

LINE	2 → → → MATERIALS USED [Enter percentage analysis or actual pounds of plant nutrients applied per acre.]			3 What quantity was applied per acre? [Leave this column blank if actual nutrients were reported.]	4 [Enter material unit code.] 1 POUNDS 12 GALLONS 19 POUNDS of ACTUAL NUTRIENTS	5 When was this applied? [Show respondent CALENDAR showcard.] MM DD YY	6 How was this applied? 1 Broadcast, ground without incorporation 2 Broadcast, ground with incorporation 3 Broadcast, by air 4 In Seed furrow 5 In irrigation water 6 Chisel, Injected or Knifed in 7 Banded in or Over Row 8 Foliar or Directed Spray 9 Spot treatments	7 How many acres were treated in this application? ACRES
	N Nitrogen	P ₂ O ₅ Phosphate	K ₂ O Potash					
01	0205	0206	0207	0208	0209	0210 _ _ _ _ _	0211	0212 _ _ _
02	0205	0206	0207	0208	0209	0210 _ _ _ _ _	0211	0212 _ _ _
03	0205	0206	0207	0208	0209	0210 _ _ _ _ _	0211	0212 _ _ _
04	0205	0206	0207	0208	0209	0210 _ _ _ _ _	0211	0212 _ _ _
05	0205	0206	0207	0208	0209	0210 _ _ _ _ _	0211	0212 _ _ _
06	0205	0206	0207	0208	0209	0210 _ _ _ _ _	0211	0212 _ _ _

99

OFFICE USE
NUMBER OF LINES IN TABLE

0213

F

PESTICIDE APPLICATIONS---SELECTED FIELD

F

EDIT TABLE

0301

1. Were any herbicides, insecticides, fungicides or other chemicals used on this field for the 1996 cotton crop?
(Include applications made in the fall of 1995 and those made earlier if this field was fallow. Include custom applied materials. Exclude seed treatment.)

T-TYPE
3TABLE
001☐ YES - [Continue.]☐ NO - [Go to Section G, page 14.]

NOTES	LINE	2 What products were applied to this field? [Use product codes from Respondent Booklet.]	3 Was this product bought in liquid or dry form? [Enter L or D.]	4 Was this part of a tank mix? [If tank mix, enter line number of first product in tank mix.]	5 When was this applied? [Show respondent CALENDAR showcard.] MM DD YY	6 OR 7		8 [Enter unit code.] 1 POUNDS 12 GALLONS 13 QUARTS 14 PINTS 15 OUNCES 30 GRAMS
						How much was applied per acre per application?	What was the total amount applied per application in this field?	
	01	0305		0306	0307 _ _ _ _ _	0308 _ _ _	0309	0310
	02	0305		0306	0307 _ _ _ _ _	0308 _ _ _	0309	0310
	03	0305		0306	0307 _ _ _ _ _	0308 _ _ _	0309	0310
	04	0305		0306	0307 _ _ _ _ _	0308 _ _ _	0309	0310
	05	0305		0306	0307 _ _ _ _ _	0308 _ _ _	0309	0310
	06	0305		0306	0307 _ _ _ _ _	0308 _ _ _	0309	0310
	07	0305		0306	0307 _ _ _ _ _	0308 _ _ _	0309	0310
	08	0305		0306	0307 _ _ _ _ _	0308 _ _ _	0309	0310
	09	0305		0306	0307 _ _ _ _ _	0308 _ _ _	0309	0310
	10	0305		0306	0307 _ _ _ _ _	0308 _ _ _	0309	0310
	11	0305		0306	0307 _ _ _ _ _	0308 _ _ _	0309	0310
	12	0305		0306	0307 _ _ _ _ _	0308 _ _ _	0309	0310
	13	0305		0306	0307 _ _ _ _ _	0308 _ _ _	0309	0310
	14	0305		0306	0307 _ _ _ _ _	0308 _ _ _	0309	0310

[For pesticides not listed in Respondent Booklet, specify--]

LINE	Pesticide Type (Herbicide, Insecticide Fungicide, etc.)	EPA No. or Tradename and Formulation	Form Purchased (Liquid or Dry)	Where Purchased [Ask only if EPA No. cannot be reported.]

Where any body is
used on the table
the table should be
it is not a table
it is a table

Table 1

Table 2

Table 3

Table 4

Table 5

Table 6

Table 7

Table 8

F

PESTICIDE APPLICATIONS---SELECTED FIELD

F

APPLICATION CODES for column 9

- | | |
|---|-------------------|
| 1 Broadcast, ground without incorporation | 7 Banded in or |
| 2 Broadcast, ground with incorporation | Over Row |
| 3 Broadcast, by air | 8 Foliar or |
| 4 In Seed Furrow | Directed spray |
| 5 In Irrigation water | 9 Spot treatments |
| 6 Chisel/Injected or Knifed in | |



LINE	9	10	11	12
	How was this product applied?	How many acres in this field were treated with this product? ACRES	Were these applications made by-- 1 Operator, Partner, Family member? 2 Custom applicator? 3 Employee/Other?	What was the PRIMARY target pest for this application? [Use Pest codes from showcard.]
01	0311	0312 . ____	0313	0314
02	0311	0312 . ____	0313	0314
03	0311	0312 . ____	0313	0314
04	0311	0312 . ____	0313	0314
05	0311	0312 . ____	0313	0314
06	0311	0312 . ____	0313	0314
07	0311	0312 . ____	0313	0314
08	0311	0312 . ____	0313	0314
09	0311	0312 . ____	0313	0314
10	0311	0312 . ____	0313	0314
11	0311	0312 . ____	0313	0314
12	0311	0312 . ____	0313	0314
13	0311	0312 . ____	0313	0314
14	0311	0312 . ____	0313	0314

F

PESTICIDE APPLICATIONS---SELECTED FIELD

F

1. [Pesticide applications, continued--]

NOTES	LINE	2 What products were applied to this field? [Use product codes from Respondent Booklet.]	3 Was this product bought in liquid or dry form? [Enter L or D.]	4 Was this part of a tank mix? [If tank mix, enter line number of first product in tank mix.]	5 When was this applied? [Show respondent CALENDAR showcard.] MM DD YY	6 OR 7		8 [Enter unit code.] 1 POUNDS 12 GALLONS 13 QUARTS 14 PINTS 15 OUNCES 30 GRAMS
						How much was applied per acre per application?	What was the total amount applied per application in this field?	
	15	0305		0306	0307 _ _ _ _ _	0308 _ _ _	0309	0310
	16	0305		0306	0307 _ _ _ _ _	0308 _ _ _	0309	0310
	17	0305		0306	0307 _ _ _ _ _	0308 _ _ _	0309	0310
	18	0305		0306	0307 _ _ _ _ _	0308 _ _ _	0309	0310
	19	0305		0306	0307 _ _ _ _ _	0308 _ _ _	0309	0310
	20	0305		0306	0307 _ _ _ _ _	0308 _ _ _	0309	0310
	21	0305		0306	0307 _ _ _ _ _	0308 _ _ _	0309	0310
	22	0305		0306	0307 _ _ _ _ _	0308 _ _ _	0309	0310
	23	0305		0306	0307 _ _ _ _ _	0308 _ _ _	0309	0310
	24	0305		0306	0307 _ _ _ _ _	0308 _ _ _	0309	0310
	25	0305		0306	0307 _ _ _ _ _	0308 _ _ _	0309	0310
	26	0305		0306	0307 _ _ _ _ _	0308 _ _ _	0309	0310
99	OFFICE USE NUMBER OF LINES IN TABLE							0319

[For pesticides not listed in Respondent Booklet, specify--]

LINE	Pesticide Type (Herbicide, Insecticide Fungicide, etc.)	EPA No. or Tradename and Formulation	Form Purchased (Liquid or Dry)	Where Purchased [Ask only if EPA No. cannot be reported.]
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

F

PESTICIDE APPLICATIONS---SELECTED FIELD

F

APPLICATION CODES for column 9

1 Broadcast, ground without incorporation	7 Banded in or
2 Broadcast, ground with incorporation	Over Row
3 Broadcast, by air	8 Foliar or
4 In Seed Furrow	Directed spray
5 In Irrigation water	9 Spot treatments
6 Chisel/Injected or Knifed in	



L I N E	9 How was this product applied?	10 How many acres in this field were treated with this product? ACRES	11 Were these applications made by-- 1 Operator, Partner, Family member? 2 Custom applicator? 3 Employee/Other?	12 What was the PRIMARY target pest for this application? [Use Pest codes from showcard.]
15	0311	0312 . ____	0313	0314
16	0311	0312 . ____	0313	0314
17	0311	0312 . ____	0313	0314
18	0311	0312 . ____	0313	0314
19	0311	0312 . ____	0313	0314
20	0311	0312 . ____	0313	0314
21	0311	0312 . ____	0313	0314
22	0311	0312 . ____	0313	0314
23	0311	0312 . ____	0313	0314
24	0311	0312 . ____	0313	0314
25	0311	0312 . ____	0313	0314
26	0311	0312 . ____	0313	0314

T-TYPE	TABLE	LINE
0	000	00

2. [If application code in column 9 is 1, 2, 7, 8 or 9, ask-]

What was the boom height of the sprayer the first time it was used
to apply pesticides on the cotton field?

INCHES

1260

G

PEST MANAGEMENT PRACTICES--SELECTED FIELD

G

1. Now I have some questions about your pest management decisions and practices used on this field for the 1996 cotton crop. By pests, we mean **WEEDS, INSECTS** and **DISEASES**.
2. Let's begin with questions about scouting this field for pests.

1	2 Was the cotton field scouted for-- [column 1] YES = 1	3 [For rows with YES = 1, ask--] Was most of the scouting for [column 1] done by-- 1 Operator, Partner or Family member? 2 an Employee? 3 Farm supply or Chemical dealer? 4 Crop consultant or Commercial scout? CODE
a. weeds	0226	0229
b. insects	0227	0230
c. diseases	0228	

3. [Ask only if column 3 of item 2 is code 4; else go to item 5.]
How much did you pay for the scouting services for this field? [Include landlord cost.]

DOLLARS AND CENTS
PER ACRE

1261

OR TOTAL DOLLARS

1262

5. [Ask only if field was SCOUTED (column 2 of item 2 is code 1); else go to item 6.]
Were written or electronic records kept for this field to track the **activity or numbers** of--

CODE

- a. broadleaf weeds? YES = 1
- b. grass weeds? YES = 1
- c. insects? YES = 1

1263

1264

1265

6. [Ask only if **HERBICIDES** (pesticide codes 4000 - 4999) were entered in Section F, item 1, column 2; else go to item 12.]
Did you apply herbicides to this field BEFORE weeds emerged?

1266

☐ YES - [Enter code 1 and continue.] ☐ NO - [Go to item 8.]

7. Did you decide to use **pre-emergence** herbicides based on--

- a. a routine treatment for weed problems experienced in previous years? YES = 1
- b. field mapping of previous weed problems? YES = 1
- c. a computerized decision model? YES = 1
- d. recommendations from an independent crop consultant? YES = 1

1267

1268

1269

1270

Phase 3, Cow Calf Version

ACRES OPERATED

1. First, I have some questions about the land in this operation. When reporting acres, include the farmstead, all cropland, government program land, pastureland, ponds, wasteland, wetland and woodland.

In 1996, how many acres did this operation--

a. own? +

ACRES

028

b. rent from others--

(1) for cash? +

029

(2) for a share of crop or livestock production? +

030

(3) free-of-charge? +

031

c. rent to others for cash, share or free? -

032

d. use for a part of the year for crops or livestock, and
rent to another operation during another part of the year?
(Exclude land rented on an AUM or fee per head basis.) +

033

2. Then the total acres in this operation was--

[Total of 1a + 1b(1) + 1b(2) + 1b(3) - 1c + 1d.] =

TOTAL ACRES

034

RENT ON ACRES and BUILDINGS

3. Including rent for buildings and land,
what was the total cash rent paid in 1996?

(Include rent paid in 1996 for previous years or rent paid in advance.)

CASH RENT PAID
DOLLARS

035

4. What was the total cash rent received in 1996

for acres cash rented to others? (Include government payments received from those acres.)

RENT RECEIVED
DOLLARS

038

5. What was the total value of the crop or livestock shares received in 1996,
for acres share-rented to others? (Include government payments received from those acres.)

DOLLARS

039

6. [Western states only.]

Does this operation ever rent any land from public agencies,
industrial corporations or grazing associations on an
animal unit month (AUM) basis?

☐ YES - [Continue.] ☐ NO - [Go to item 11.]

- a. In 1996, what were the Total Usage Fees that
this operation paid for the use of this land?

(Include fees paid for privately owned land administered
by a public agency through exchange-of-use.)

TOTAL DOLLARS

040

A

ACREAGE and PRODUCTION

A

11. What crops were harvested during 1996 on the total acres (item 2) in this operation?

1 CROP	2 CROP CODE	3 How many acres of [crop] were harvested? → ACRES	4 What was the total production?	5 UNIT CODE 1 POUND 2 CWT 3 TON 4 BUSHEL 5 BARREL 6 BALE	6 How much (of this operation's share) was or will be used on this operation?	[Ask if SHARE Rented Land from others.]	
						7 What amount of production was the landlord's share?	8 What was the market value of the landlord's share of this/these crop(s)? DOLLARS
CORN for grain		057	058	059	060	061	
		062	063	064	065	066	
CORN for silage							
COTTON (Upland, Pima)		067	068	069	070	071	
FRUITS AND NUTS, ALL		072					073
HAY, ALFALFA		074	075	TONS	076	077	
HAY, ALL OTHER		078	079	TONS	080	081	
NURSERY AND GREENHOUSE CROPS, ALL		082					083
SOYBEANS		084	085	086	087	088	
SUGARCANE OR SUGARBEETS		089	090	TONS			091
VEGETABLES AND MELONS, ALL		092					093
WHEAT, ALL for grain		094	095	096	097	098	
STATE-SPECIFIC CROPS: [List here]							
	099	100	101	102	103	104	
	105	106	107	108	109	110	
	111	112	113	114	115	116	
	117	118	119	120	121	122	
ALL OTHER CROPS (Specify below)		123					124

B

FARM/RANCH PRODUCTION COSTS

B

EXCLUDE LANDLORD and CONTRACTOR EXPENSES

RENTAL AND/OR LEASING COSTS

14. What was the TOTAL AMOUNT this operation spent in 1996 for renting or leasing tractors, cars, trucks, farm and irrigation equipment and storage structures used for the farm/ranch?

DOLLARS

194

SUPPLIES AND REPAIRS

15. In 1996, how much was spent for all farm supplies, marketing containers, hand tools and farm shop power equipment?

DOLLARS

195

(Include expenses for temporary fencing. Exclude expenses for permanent fencing.) .

16. In 1996, how much was spent for--

- a. repairs, parts and accessories for motor vehicles, drying equipment and frost protection equipment?

(Include tune-ups, overhauls, repairs to livestock equipment, replacement parts for machinery, tubes, tires, and accessories such as air conditioners, CBs, radios and hydraulic cylinders.) +

DOLLARS

196

- (1) How much of this expense (item 16a) was for beef production, excluding feedlot cattle?

PERCENT OR DOLLARS

197

198

- b. maintenance and repair of all fencing, houses other than the operator's, farm buildings, land improvements and all other farm/ranch improvements?

(Include conservation improvements, corrals, feeding floors, feedlots, gravel, land drainage structures, tiling, trench silos, waste facilities, wells and facilities to improve productivity, etc. In Western states include capital improvements to grazing land.

Exclude any new construction or remodeling expenditures.

Report irrigation and pumps in item 16C below.] +

199

- (1) How much of this expense (item 16b) was for specialized livestock production facilities (dairies, feedlots, swine buildings, poultry houses, etc.)?

PERCENT OR DOLLARS

200

201

DOLLARS

202

- c. maintenance and repair of irrigation equipment and pumps? +

17. Then the total amount spent for maintenance and repair was--

DOLLARS

205

(Total of 16a + 16b + 16c =) =

DOLLARS

206

18. If it was owned by the operation, how much was spent on maintenance and repair of your (the operator's) house?

['Owned by the operation' means the house is--

- recorded as an asset in farm record books, or
- used as security or collateral for a farm loan, or
- deeded as part of the farm.]

C

COMMODITY MARKETING and OTHER INCOME

C

MARKETING CONTRACTS

1. During 1996, did this operation have Marketing Contracts or formal agreements for any commodities it produced?

☐ YES - [Complete the table below.] ☐ NO - [Go to item 2.]

EXCLUDE CONTRACTOR EXPENSES

1 What commodities did this operation have MARKETING contracts for in 1996? [WRITE IN COMMODITIES LIST EACH CONTRACT.]	2 OFFICE USE CODE	4 What quantity of [commodity] was marketed through this contract? (Exclude landlord's share.) [Specify UNIT in column 5.] QUANTITY	5 UNIT CODE 1 POUND 2 CWT 3 TON 4 BUSHEL 5 BOX 6 BALE 7 CARTON 8 DOZEN 9 FLAT 10 HEAD 11 ACRE 22 ACRE 20 OTHER	6 What was (will be) the Final Price Received per Unit by this operation for [commodity] marketed under this contract? [Same units as column 5.] DOLLARS & CENTS	7 What was the total dollar amount received in 1996 from this contract? [Record receipts less marketing charges.] 1/ TOTAL DOLLARS
	261	281	291	301 • — —	311
	262	282	292	302 • — —	312
	263	283	293	303 • — —	313
	264	284	294	304 • — —	314

PRODUCTION CONTRACTS for CONTRACTEES

EXCLUDE CONTRACTOR EXPENSES

2. During 1996, did this operation have Production Contracts or formal agreements to produce any commodities for a processor, packer, canner, integrator or another operation, etc.?

☐ YES - [Complete the table below.] ☐ NO - [Go to item 5.]

1 What commodities did this operation have PRODUCTION contracts for in 1996? [WRITE IN COMMODITIES LIST EACH CONTRACT.]	2 OFFICE USE CODE	4 What quantity of [commodity] was removed from the operation under this contract during 1996? [Specify UNIT in column 5.] QUANTITY	5 UNIT CODE 1 POUND 2 CWT 3 TON 4 BUSHEL 5 BOX 6 BALE 7 CARTON 8 DOZEN 9 FLAT 10 HEAD 11 ACRE 22 ACRE 20 OTHER	6 What was (will be) the Final Fee Received per unit by this operation for producing [commodity] under this contract? [Same units as column 5.] DOLLARS & CENTS	7 What were the Total Fees Received under this contract in 1996 ? 1/ TOTAL DOLLARS
	321	341	351	361 • — —	371
	322	342	352	362 • — —	372
	323	343	353	363 • — —	373
	324	344	354	364 • — —	374

1/ Exclude money received from contractors as reimbursement for expenses. These should be recorded in Section D. Income received for commodities marketed or produced under contract in previous years should be recorded in item 11 in this Section.

OFFICE USE-SHARES
259
EXP

OFFICE USE-SHARES
260
INC

C

COMMODITY MARKETING and OTHER INCOME

C

CASH OR OPEN MARKET SALES - LIVESTOCK

9. Did this operation sell any livestock, poultry or dairy or poultry products for cash or on the open market in 1996?

[Exclude marketing contract sales reported earlier. Include partner's share.]

☐ YES - [Continue.] ☐ NO - [Go to item 11.]

10. Excluding any marketing expenses, what was the net dollar amount received for cash or open market sales of--

NET
CASH SALES
DOLLARS

- a. all dairy and beef cattle sold for **breeding stock**?
- b. all other cattle? (Include cull dairy animals and culls from beef breeding stock.)
- c. all hogs sold for **breeding stock**?
- d. all other hogs?
- e. milk and other dairy products before deduction of any hauling fees?
(Include butter, cheese, cream, etc.)
- f. all eggs?
- g. all poultry and poultry products? (Include broilers, hens, turkeys, etc.
Record income from ducks and game birds in 10h.)
- h. all other livestock or livestock products? (Include bees, fish, ducks, game birds,
goats, mohair, honey, horses, mink, rabbits, sheep, wool, etc.)

466
467
468
469
470
471
472
473

11. Including any deferred receipts, did this operation receive any money in 1996 that it was owed at the end of 1995 for commodity sales?

☐ YES - [Continue.] ☐ NO - [Go to item 12.]

What was the total dollar amount this operation received in 1996 for--

DOLLARS

- (a) commodities sold under Marketing Contracts in previous years?
- (b) commodities grown or raised under Production Contracts in previous years? . . .
- (c) Cash or Open Market sales of commodities in previous years?

474
475
476

